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A New Species of *Mitoura* Scudder from Southern California (Lepidoptera: Lycaenidae)

John W. Brown[1]

791 My Way, San Diego, CA 92154

Abstract. A new species of *Mitoura* Scudder from southern California, *M. thornei*, is described and figured. The insect is isolated by geography and the use of a select hostplant. The larval host is the endemic Tecate cypress, *Cupressus forbesii* Jepson (Cupressaceae), with which the adults are intimately associated. Data regarding the insect's spatial and temporal distribution are presented, and the early stages are briefly discussed.

Introduction

The use of Coniferae as a larval host is quite limited among the Nearctic Rhopalocera. Only *Neophasia* Behr (Pieridae), *Incisalia* Scudder (Lycaenidae), and *Mitoura* Scudder are known to utilize Pinaceae and Cupressaceae (Howe, 1975). Host specificity, as is commonly encountered in the genus *Mitoura (sensu stricto*, the Cupressaceae-feeders), has been shown to be a potentially useful tool in dealing with butterfly taxonomy (Downey, 1962). The discovery of the monophagous *Mitoura hesseli* Rawson and Ziegler (1950), as a sibling species of *M. gryneus* (Huebner), demonstrates this value (Johnson, 1978). For many species, host specialization has resulted in restriction of range to small areas of acceptable habitat. Subsequent isolation of these regions may in time be the basis of local population differentiation, and eventually even speciation.

A unique and highly localized population of *Mitoura* was discovered in the vicinity of Otay Mountain in southern San Diego County, California, several years ago. Its geographic isolation and close association with the endemic Tecate cypress (*Cupressus forbesii* Jepson) strongly suggested that the insect was distinct from its congeners. Not coincidentally, the Otay Mountain area has long been known for its high degree of floral endemicity. Subsequent to its discovery, the insect became the subject of investigation by Fred T. Thorne. The majority of the data herein presented represents his research efforts.

Discovery

While working with Paul Ehrlich's *Euphydryas editha* (Bosiduval) population study group from Stanford University, Thorne collected a

single male *Mitoura* near Lower Otay Lake, 26 February 1972. No *Mitoura* were previously known from cismontane southern California since hosts for neither *M. loki* (Skinner) nor *M. nelsoni* (Boisduval) occur here. The only possible cupressaceous host available was Tecate cypress.

Upon suggestion of Thorne, David Hawks, a local lepidopterist, kept a watchful eye and managed to collect several specimens of the *Mitoura* while on a San Diego Natural History Museum field trip to the northeast slope of Otay Mountain, 8 March 1974. The insect was indeed closely associated with the endemic cypress.

In the years that followed, several lepidopterists were able to sample the *Mitoura* population at Otay Mountain and the adjacent Little Cedar Canyon area near Lower Otay Lake. Fred Thorne was eventually successful in obtaining eggs from live females, and reared the insects through to maturity several times, carefully recording the life history and developmental periods required by the insect (Fig. 6).

As southern California represents one of the greatest concentrations of lepidopterists in the country, it is remarkable that this insect remained undiscovered until 1972. Inaccessibility to the Otay Mountain area was undoubtedly the major deterrent. Although much of the area is under the direct control of the Bureau of Land Management, rough dirt roads severely hinder travel; furthermore, private ownership of adjacent land and owner reluctance to allow access has inhibited collecting activities in the area.

Based on phenotypic characters, a highly selective host preference, and a unique ecological association, the Otay Mountain *Mitoura* appears to represent a distinct species and, accordingly, is herein described.

Systematic Description

Mitoura thornei J. W. Brown **new species**

Figure 1, Row b

Male: Forewing length $\bar{x}$ = 12.7 mm (range 11.5-14.0 mm). Head, thorax, and abdomen dark brown. Thorax dorsally covered with fine, long, brown body scales, ventrally covered with light brown to whitish gray scales. Abdomen thickly clothed in short, lighter brown imbricate rows of hair. Antennae black with a thin white band at each segmental joint; club black with a white streak ventrally near the base. Palpi black with scattered white scales. Eyes dark brown encircled by a fine white line of scales. Dorsal surface of forewing rich reddish brown with dark brown shading on costal margin, basal and postbasal areas, apical and subapical areas, and along the outer margin. Major veins also indicated by dark brown scaling. Male scent pad well developed. Hindwings concolorous with forewings, with extensive basal and marginal darkening. A fine white submarginal line between Cu_2 and 2ndA. A very short, slender, black hair-like tail at the end of Cu_1, tipped with white; and a longer tail at the end of Cu_2. Ventral surface of forewing mahogany brown with faint traces of lavender overscaling, heavier near apical and basal areas. A well-defined white submarginal line composed of five dashes interrupted only by the major forewing

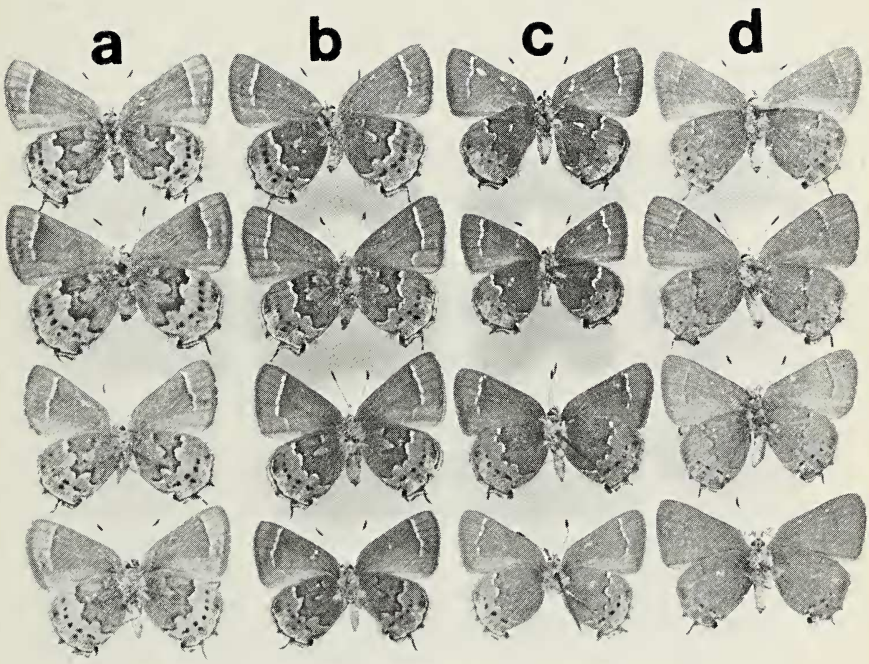

Fig. 1. Ventral aspect of four specimens of each of the related taxa: **a)** *Mitoura loki,* **b)** *M. thornei,* **c)** *M. nelsoni muiri,* **d)** *M. nelsoni nelsoni.*

veins. Offset basally is an additional longer, faint, white curved dash (present only in reared material) just below the well-defined line. Hindwings lustrous grayish lavender below, with a broad maroon-to-brown discal band. Rarely the entire surface is dusted with green overscaling. An irregular, though well-defined, white postmedian line at the outer edge of the discal band. A submarginal row of 6 (variable from 4 to 7) black terminal spots present in the light limbal zone. "*Thecla*" spot well defined. Terminal area between the row of black spots and the outer margin inconsistently marked with areas of heavy iridescent pale blue scaling.

Female: Forewing length $\bar{x}$ = 13.0 mm (range 11.5-14.0 mm). Similar in color and maculation to the male; without scent pad on upper surface of forewing.

Genitalia: Illustrated for both sexes of *M. thornei* and 3 related taxa, *M. loki, M. nelsoni,* and *M. nelsoni muiri* (Hy. Edwards) in Fig. 2. My analysis is based on two specimens of each sex of the four taxa. The drawings were made from the KOH macerated abdomens being placed in Hoyer's medium on temporary slides, and illustrated using a Wild 5A stereo microscope with drawing attachment. Thus artifacts of cover slips and positioning could be minimized.

The characters and their states were those employed by Johnson (1976b, 1978). On the basis of the limited samples, and the variation found, it would appear that

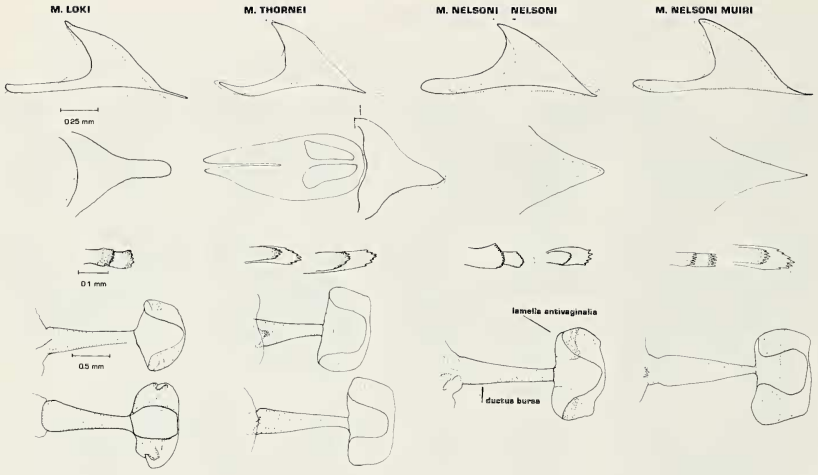

Fig. 2. Selected characters and variation in character states based on paired specimens of each of those related taxa: *M. loki, M. thornei, M. nelsoni nelsoni* and *M. nelsoni muiri.* **Top row**, valvae in lateral aspect. The first specimen drawn with solid line, the second with dotted line. **Second row**, saccus in ventral aspect (both *M. loki* identical, *M. thornei* showing valvae as well in ventral aspect). **Third row**, distal morphology of dorsal and ventral sets of cornuti (*M. loki* both identical). **Last rows,** with ductus bursa (sclerotized), and lamella antivaginalis in dorsal aspect. Portion of corpus bursae to left. *M. nelsoni* and *M. nelsoni muiri* specimens identical.

these characters do not provide reliable means to differentiate the entities. Preparation of longer series of material may well provide quantitative differences between populations, but these are in all probability meaningless as states upon which "species" or "subspecies" categories can be based. Refer particularly to the two ductus bursae samples of *M. thornei* and the dorsae and ventral sets of cornuti in *M. nelsoni*. Lateral shape of the valva are not of convincing value (e.g., *M. nelsoni*), although the construction in the caudal section of the corpus bursae of *M. nelsoni muiri*, consistent and unique in both specimens, is suggestive.

Types: Holotype, male, California, San Diego County, Little Cedar Canyon, north slope of San Ysidro Mountains (Otay Mountain), east end of Lower Otay Lake, 200 m, 32°37'N, 116°52'W, ex-female, ex-ovum, emerged 4 May 1980 (laboratory reared); allotype, female, same locality as holotype, ex-female, ex-ovum, emerged 28 October 1979 (laboratory reared). Described from 178 specimens collected and/or reared from 26 February 1972 to 6 March 1982.

Disposition of types: The holotype male and allotype are deposited in the collection of the San Diego Natural History Museum. Representative examples from the paratype series are deposited in the following institutions: California Academy of Sciences, San Francisco, California; Los Angeles County Museum of Natural History, Los Angeles, California; Allyn Museum of Entomology, Sarasota,

Florida; American Musuem of Natural History, New York; United States National Museum, Washington, D.C.; and Carnegie Museum of Natural History, Pittsburgh, Pennsylvania. Paratypes are also deposited in the following private collections: J. W. Tilden, San Jose, California; John Lane, Santa Cruz, California; and Fred Thorne, El Cajon, California. The remainder of the paratype series deposited in the collection of the San Diego Natural History Museum.

Etymology: The name *thornei* is derived from Fred T. Thorne. Mr. Thorne discovered and originally investigated this interesting insect. His work on the butterflies of San Diego County, California, and the Nearctic Theclinae is widely known and respected.

Discussion

Mitoura thornei is isolated by geography and the use of a select hostplant. In southern California its closest relative appears to be *M. loki* (Fig. 1a) which it resembles in voltinism (multiple brooded), phenotype, and genitalic charcters. It is distinguishable from *M. loki* in host preference and in the color of the ventral hindwing surface. *M. thornei* is not similar in appearance to *M. nelsoni* (Fig. 1d); additionally, southern California populations of *M. nelsoni* are all univoltine. However, the use of a *Cupressus* species as the larval host suggests a close affinity with *M. nelsoni muiri* (Fig. 1c), an entity which some authors feel is worthy of specific consideration (Johnson, 1976b). The Otay Mountain *Mitoura* is phenotypically similar to *M. nelsoni muiri*; furthermore, these two insects occupy habitats that are quite similar although considerably disjunct (Fig. 3). *M. thornei* is easily distinguished from *M. nelsoni muiri* by the presence of markings in the basal area of the ventral hindwing; the basal area of *M. nelsoni muiri* is totally devoid of markings. Also, *M. nelsoni muiri* is univoltine (Opler and Langston, 1968). Although no sympatry occurs, *M. thornei* is separated from the nearest *M. loki* population by only about 60 km, and from the nearest *M. nelsoni* population by about 50 km.

The host for the Otay Mountain *Mitoura* is Tecate cypress, a closed-cone conifer which occurs on xeric slopes in the chaparral. Although possibly widespread in the Neocene (Axelrod, 1967), Tecate cypress is now restricted to a relatively few isolated stands extending from the Santa Ana Mountains of Orange County, California, south into northern Baja California, Mexico (Little, 1971) (Fig. 4). Where it occurs it is often the dominant plant, the trees generally surpassing most of their shrubby competitors in the chaparral community (Zedler, 1977). Fire plays an integral part in the natural history of these trees as it is the major factor that initiates cone opening and seed dispersal. Chaparral fires have undoubtedly caused great fluctuations in the population of both the cypress and the associated *Mitoura*. Although the insect is known only from the Otay Mountain area, it may possibly occur throughout the natural range of the host. A rather extensive stand of Tecate cypress occurring in the Sierra Peak-Coal Canyon area of northeastern Orange County appears

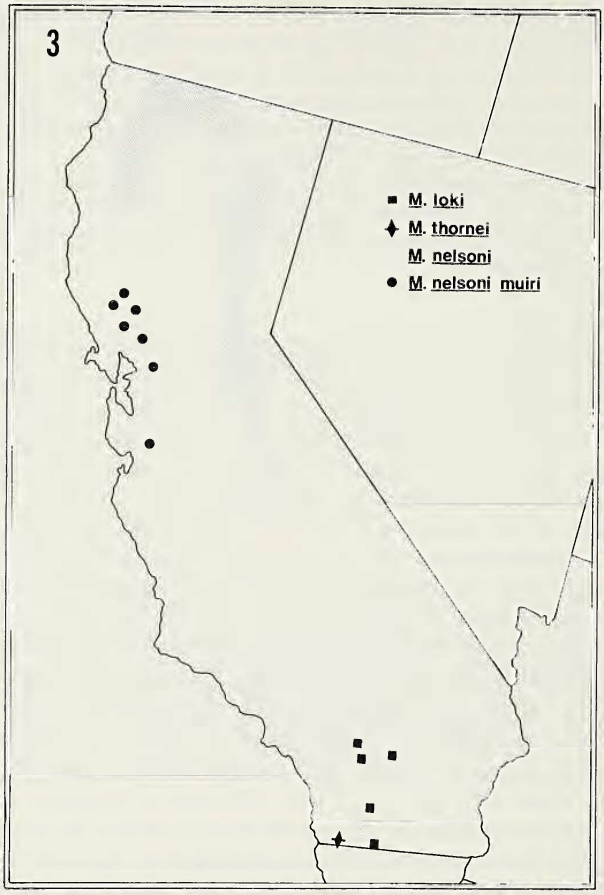

Fig. 3. General California distribution of the four related taxa discussed in the text. *M. loki* associated with *Juniperus californica* Carr.; *M. thornei* known only from Otay Mountain; *M. nelsoni* distributed throughout the range of *Calocedrus decurrens* (Torr.) Florin.; *M. nelsoni muiri* found only in association with *Cupressus sargentii* Jepson.

to provide an ideal habitat for the insect. However, limited sampling of the area (Orsak, 1977; Brown and Faulkner, personal observation) has failed to yield any *Mitoura*. It has been suggested that this stand of cypress represents an introduced population, but the available data indicates such is unlikely. The entire area was completely ravaged by chaparral fires in the recent past, which might possibly have eliminated any relict *Mitoura* population that formerly existed. Extraordinarily, a single specimen of *Mitoura* is known from Isla Guadalupe, over 230 km off the western coast of Baja California, Mexico (Powell, 1958). The insect has been determined

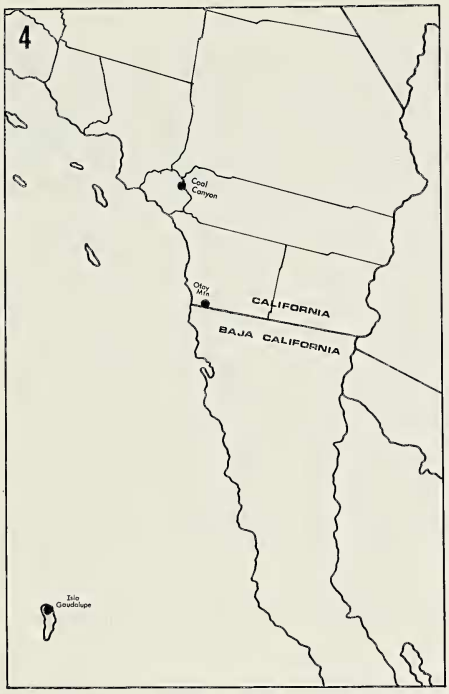

Fig. 4. Spatial distribution of *Cupressus forbesii*. Stippling represents stands of trees. Dots indicate localities mentioned in text.

by John Lane as *M. nelsoni muiri*, and the suspected larval host is the endemic, insular *Cupressus guadalupensis* S. Watson. However, many botanical taxonomists consider *C. guadalupensis* conspecific with *C. forbesii*; thus this Isla Guadalupe insect bears a biological affinity to *M. thornei*, at least in food plant usage.

Mitoura thornei appears to be at least double brooded; adults are on the wing in March and again in June (Fig. 5). Capture records indicate the second brood may only be a partial one, as is the case with *M. loki* and the eastern *M. gryneus* and *M. hesseli*. Phenotypically the two broods are similar, the summer brood being just slightly darker in color.

Although several nectar sources are utilized, adults are more commonly encountered by "tapping" the branches of the host tree. Males generally perch near the top branches and are quite easily disturbed. Their quick, erratic flight, however, makes them difficult to capture. Nectar sources include manzanita (*Arctostaphylos otayensis* Weis. and Schreib.), California or flat-top buckwheat (*Eriogonum fasciculatum* Bentham), and Yerba Santa (*Eriodictyon* sp.).

Early Stages

The early stages of *M. thornei* closely resemble those described for *M. siva* (W. H. Edwards) (Coolidge, 1924), *M. loki* (Comstock and Dammers, 132a), and *M. nelsoni* (Comstock and Dammers, 1932b). Eggs, light green in color and echinoid in shape, are laid singly on the new growth of the host. The egg stage lasts 7 to 14 days (Fig. 6). The newly hatched larvae initially bore into the young stems of the host but become external feeders as they develop. Mature larvae closely resemble the terminal twigs on which they feed. Their color is vivid green with two irregular white crescents on each segment, one on either side of the middorsal crest; the markings together form a longitudinal stripe on each side of the body. Additionally, there is a thinner, more consistent longitudinal white stripe above the prolegs on each side of the larva. The entire body is covered with minute brown hairs. Complete larval development requires 26 to 35 days under laboratory conditions. Although females exhibit a distinct ovipositional preference for *Cupressus forbesii*, larvae will develop normally on California juniper (*Juniperus californica* Carr.) in the lab. The pupae are dark chestnut brown with fine mottling, and are covered with fine brown hairs; the wing cases are bare. Pupation generally occurs in the duff or debris at the base of the host trees (David Faulkner, personal communication).

Conclusion

The genus *Mitoura* has been the subject of many taxonomic, biological, and regional studies, most recently by Clench (1981) and Johnson (1976a, 1976b, 1978). However, a number of unresolved problems still remain,

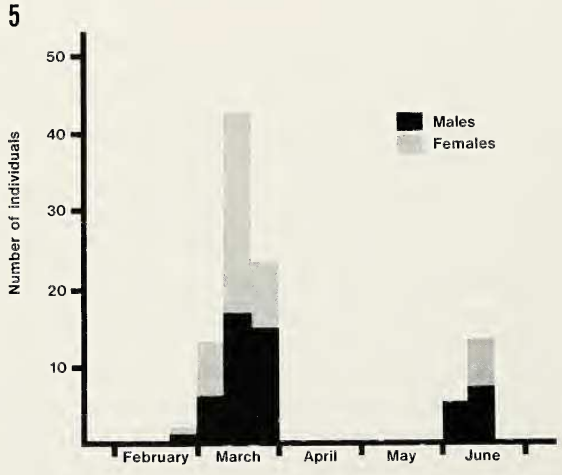

Fig. 5. Flight period graph of *Mitoura thornei* based on all wild caught adults examined.

particularly with the western populations of *M. siva* and *M. nelsoni*, and no taxonomic diagnosis of the species complex is widely accepted. Johnson (1976b) suggests a standard method for species assessment using characters of wing color and maculation, genitalia, and food plant usage. Unfortunately, recent workers, including Johnson, have relied almost exclusively on genitalic characters and, in general, have included other information only in support of their genitalic diagnosis. The limited data presented above (Genitalia) indicates that the genitalia of *Mitoura* are of very limited taxonomic significance, certainly in a practical sense, and other criteria must be used in attempting to understand relationships and phylogeny. Furthermore, conclusions concerning "isolating mechanisms" based on these cryptic differences are certainly meaningless (Shapiro, 1978). Lafontaine (1981), in classifying a group of *Euxoa* Huebner (Noctuidae), which as *Mitoura* showed substantial patterns of variation with minor differentiation of genitalia, was able to construct a convincing phylogeny by careful methodology. Our understanding of *Mitoura* has not yet progressed as far. In the closely related genus *Callophrys* Billberg, often considered congeneric with *Mitoura*, the genitalia are also of little or

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BROOD YEAR	FIRST OVA LAID	FIRST EGG HATCH	DAYS IN OVUM	FIRST PUPAE	LARVAL DAYS	FIRST IMAGO	PUPAL DAYS	TOTAL DAYS IN CYCLE
1976	20.III.76	1.IV.76	11	3.V.76	33	15.V.76	12	56
1977	18.VI.77	25.VI.77	7	23.VII.77	28	3.VIII.77	11	46
1978	11.VI.78	18.VI.78	7	22.VII.78	34	15.II.79	208	249
1979	9.III.79	21.III.79	12	16.IV.79	26	2.V.79	16	54
1980	5.III.80	19.III.80	14	23.IV.80	35	6.VII.80	42	92

Fig. 6. Developmental periods required by *M. thornei*. Data from broods reared by Fred Thorne.

no value in distinguishing the species (Dornfeld, 1980). Although genitalic characters of *M. thornei* do not convincingly separate it from either *M. loki* or *M. nelsoni*, wing color and maculation, host specificity, and asynchronous peak flight periods do clearly distinguish these closely related entities.

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